Correlation of ADC values for Tumour and Non-Tumour areas of Prostate Cancer as defined by Histopathology at Prostatectomy

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Introduction: Magnetic Resonance Imaging is increasingly being used in the pre-treatment workup for prostate cancer. High resolution T2weighted imaging alone has a low sensitivity and specificity (around 70%) for tumour detection. This is particularly difficult within the central gland as a result of the presence of benign Prostatic Hyperplasia (BPH). Diffusion weighted (DW)-MRI is showing promise in the detection of prostate cancer when combined with T2w imaging [1]. The purpose of this study was to determine the sensitivity and specificity of diffusion weighted magnetic resonance imaging (DW-MRI) for localization of prostate cancer when compared with histopathology at prostatectomy.

Method: Ten patients referred for routine clinical evaluation prior to prostatectomy at our MR centre underwent DW-MRI in addition to their standard T2W MRI. Patient characteristics were: age (57-76 yrs, mean 61.7yrs), stage T1 (n=8)/T2 (n=2), Gleason Grade 3+3 (n=6), 4+3(n=4), PSA 4.1-13.2 ng/mL (mean 8.01). A Philips Intera 1.5T scanner, with a balloon design endorectal receiver coil inflated with 55mls of air, was used to acquire T2W FSE images in 3 orthogonal planes together with axial DW images with 4 b values (0, 300, 500 and 800 s/mm^2). All axial imaging was acquired at the same offsets and angulations at an angle perpendicular to the posterior edge of the gland.

Histopathology: The fresh whole mount prostate was placed on its posterior side and cut using the technique and apparatus as developed by Jhavar et al [2]. The fresh slices were photographed using a digital camera (Nikon D100 SLR, Nikkor Microlens), then processed in the normal way. Areas of tumour were outlined on the slides by an experienced histopathologist at the time of report. These outlines were then photographed.

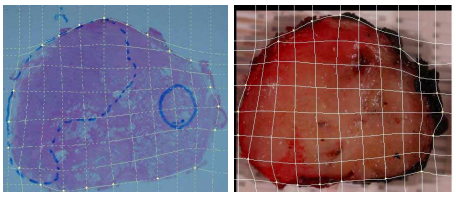

Fig.1 Mesh created to morph the histo to the fresh slice

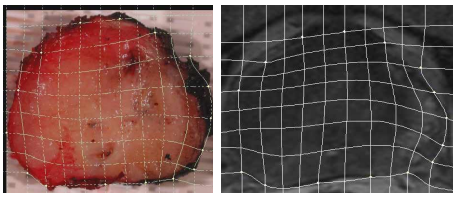

Fig.2 Mesh created to morph the fresh to the MR slice

Results: Isotropic ADC values are given for regions of tumour 1347.48 ± 147.63, non-tumour PZ 1572.74 ± 83.86, and for CG 1454.60 ± 95.92. (**Fig.4**). There was a significant difference in the ADC values between groups (p=0.001). There was also a significant difference in ADC values between tumour and PZ (p=.001) and between PZ and CG (p=.009). The difference in mean ADC between tumour and CG was not significant (p=.07).

Registration: Software written in-house (in IDL) was used to draw Regions of interest (ROI's) on all slices of the T2W axial scans around the whole prostate and the central gland. An ROI was also drawn around the whole prostate on the ADC maps. ADC maps were co-registered with the T2W scans by matching slice position and aligning the centre of mass. Using gtkMorph (GNU General Public License) one control mesh is created between the fresh slice and the stained section (**Fig.1**) and another between the high-resolution MR image and the photograph of the fresh slice. (**Fig.2**). The morphing is first applied to the photograph of the stained section with the tumour outlines, so as to shape it like the fresh-tissue slice which is subsequently morphed to the T2W axial slices. This was done to cover the region from base to apex of the gland. The technique was used previously by Reinsberg et al [3]. ROI's from the T2W images were transferred to corresponding slice ADC maps that had been generated using all b values (**Fig.3**). The successively morphed outlines produced ADC values from Tumour, Central Gland (CG) and Peripheral Zone (PZ) (whole prostate minus central gland and tumour).

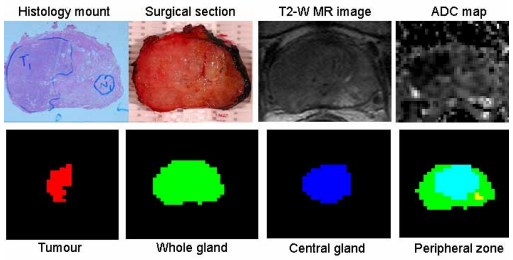

Fig 3. Shows the matched images with the Histo and Radiology defined ROI's.

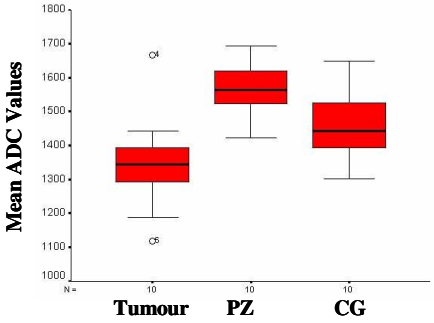

Fig.4 Comparison of ADC values for Tumour, normal PZ and normal CG.

Discussion and Conclusion: Considerable distortion of the prostate gland occurs at prostatectomy and subsequent handling, fixation and processing of the specimen. The use of morphing techniques allows histologically defined tumour ROI's to be transferred to the MR data sets. However the technique requires intensive visual matching of anatomic features by an experienced operator. We have shown that in agreement with previous findings prostate cancer has a lower ADC value than non-malignant PZ [1, 4]. This study additionally demonstrates a trend for lower ADC values in tumour when compared with normal CG although this was not significantly significant. This suggests that ADC values offer potential for increasing the sensitivity and specificity of MR Imaging for improving detection of prostate cancers, particularly those in the CG.

References: [1] deSouza NM et al BJR 2007 (in press). [2] Reinsberg S et al Proc. Intl.Soc. Mag. Reson. Med. 11 (2004). [3] Jhavar S G et al J. Clin. Pathol. 2005;58;504-508. [4] Shimofusa R et al J Comput Assist Tomogr 2005; 29(2):149-153.